

Rating Agencies in the Face of Regulation

Rating Inflation and Regulatory Arbitrage^{*}

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Abstract

This paper develops a rational expectations model to analyze how rating agencies alter their information acquisition and disclosure policy when ratings are used for regulatory purposes such as bank capital requirements. Although rating agencies generally publish informative ratings, sufficiently large regulatory distortions may lead to a complete break-down of delegated information acquisition – rating agencies merely facilitate regulatory arbitrage by selling inflated ratings to originators. Our model reveals that this result is more likely to occur in complex security classes and how, in general, the impact of regulation on ratings depends on the cross-sectional distribution of borrower types.

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1 Introduction

"The story of the credit rating agencies is a story of colossal failure."

Henry Waxman (D-CA), chairman of the House Oversight and Government Reform Committee.

Rating agencies have been criticized by politicians, regulators and academics as one of the major catalysts of the 2008/2009 financial crisis. One of the most prominent lines of attack, as voiced by Henry Waxman, is that rating agencies "broke the bond of trust" and fooled trusting investors with inflated ratings. However, should sophisticated financial institutions be realistically categorized as trusting and fooled investors in light of the fact that they interacted with rating agencies not only as investors but also as originators of highly rated subprime mortgage backed securities? Why would these institutional investors care about ratings when they experienced "dubious" rating agencies' practices first hand?

We argue, that a first-order benefit to financial institutions results from the regulatory use of ratings, such as minimum bank capital requirements. Over the last 20 years bank capital requirements (Basel I guidelines (1988) and Basel II guidelines (2004)) have become increasingly reliant on ratings as a measure of risk. For example, banks must hold five times as many reserves against *BBB+* securities than against *AAA* securities. Moreover, the investment-grade threshold and the *AAA* threshold have become regulatory investment restrictions for pension and money market funds. Since these regulations are of first order relevance for institutional investors' capital management, a *AAA* label is economically valuable, independently of the underlying information it provides about the risk of a security. A recent empirical study by Strahan and Kisgen (2009) estimates the economic value of a one notch better rating to be 42 basis points.¹

Consistent with these observations, we develop a rational-expectations model of the "rating game" in which institutional investors face regulatory constraints that are contingent on ratings. The model reveals how rating-contingent regulation distorts the business model of rating agencies and may, at least in part, reconcile rating inflation in select asset classes and low risk premia (see Coval, Jurek, and Stafford (2009)) with investment by rational investors that are aware of the rating agencies' practices.

In the absence of regulation, the rating agency's optimal information acquisition and disclosure policy trades off the marginal cost of information acquisition with the increase in surplus it can extract from firms by providing information to investors. The repeated interaction with the credit market allows the rating agency to commit to the disclosure of informative ratings. We show that regulatory benefits that are tied to high ratings change the rating agency's equilibrium choices along two dimensions: a) the amount of information it acquires and b) the information it discloses to the public.

If regulatory benefits are above a threshold, the rating agency stops acquiring information and simply engages in rating inflation by disclosing high ratings: the rating agency effectively

¹ Strahan and Kisgen (2009) use the regulatory accreditation of Dominion Bond Rating Services as a natural experiment to identify the impact of regulation. In the United States, 10 rating agencies are recognized by the SEC, the so called NRSROs. Sangiorgi, Sokobin, and Spatt (2009) provide an excellent summary of the regulatory use of ratings. Bongaerts, Cremers, and Goetzmann (2009) also document the first-order importance of rating-contingent regulation by exploiting the regulatory treatment of securities that are rated by multiple rating agencies.

becomes a regulatory arbitrageur rather than a provider of information. This extreme result is more likely to occur for complex securities that are costly to evaluate.² Two observations may be explained by this result: the apparent low effort by rating agencies to create sophisticated models for the mortgage market, an area outside of the rating agency's primary expertise, and the fact that exotic, structured securities receive a much higher percentage of *AAA* ratings (e.g., 60% for CDOs) than do corporate bonds (1%, see Fitch (2007)).

The effect of changes in regulatory benefits is ambiguous when benefits are below the above-mentioned threshold (so that the rating agency chooses to provide informative ratings). It is possible that the rating agency acquires more or less information in response to an increase in regulatory benefits. We show that these comparative statics depend on the distribution of types in the cross-section. If there are more bad types than good types, the rating agency will acquire less information in response to an increase in regulatory benefits, enabling more securities to be classified *AAA*. In the opposite case, the rating agency increases its information acquisition in response to an increase in regulatory benefits. Our model also reveals that reputation acquisition is facilitated by rating multiple issuers at the same time, a benefit of cross-sectional diversification in the spirit of Diamond (1984) and Ramakrishnan and Thakor (1984).³ This may explain the oligopolistic market structure of rating agencies.

We develop these results in a simple, parsimonious model by incorporating a monopolistic rating agency into a standard private-prospects model in which firms have private information about their type. We call the issuers firms but they could be interpreted more generally as originators of debt. There is a continuum of firms with two types of projects, positive NPV projects and negative NPV projects. The rating agency has access to an information acquisition technology that generates private, noisy, binary signals about the type of a project. The precision of the signal is a continuous choice variable for the rating agency and determines the incurred information acquisition cost. The rating agency may truthfully disclose its private signals to the public or disclose biased ratings. Information acquisition and disclosure thus jointly determine the informativeness of ratings. Due to cross-sectional diversification, the informativeness ratings may be inferred after each period from the fraction of firms that defaulted in a given rating category. In a repeated game, public information of the informational content of ratings yields the rating agency a commitment device.

Without regulation, the rating agency can extract rents from its ability to alleviate the information asymmetry between originators and investors. Disclosed ratings affect investors' information sets and thereby the efficiency of capital allocations in the economy. In equilibrium, the rating agency finds it optimal to acquire information and to truthfully disclose this information to the public. Truthful disclosure is optimal as it maximizes the rents the rating agency can extract for any given amount of private information it has.

The introduction of regulatory benefits distorts the rating agencies incentives to acquire and disclose information. Since regulatory benefits in practice depend only on the rating label (and not the underlying informativeness), there is an incentive to rate more firms favorably (volume

² For this result, it is crucial that current regulations only depend on the rating but do not distinguish between types of securities: The regulator treats *AAA* corporate bonds identically to *AAA* senior tranches of collateralized debt obligations.

³ Our mechanism differs from these classical papers as the rating agency is not the residual claimant of the assets it rates. Hartman-Glaser, Piskorski, and Tchisty (2009) consider the optimal mortgage securitization problem from the perspective of an issuer. Independently from our analysis, they find an "information enhancement" effect if the underwriter securitizes multiple assets at the same time.

effect). However, for small benefits, full disclosure is still the optimal disclosure. As a result, the interaction of the signal structure with the cross-sectional distribution of types plays a crucial role. This interplay generates the model's predictions with regards to the skewness of the cross-sectional distribution. If the regulatory benefits are sufficiently large, the rating agency has an incentive to distort information disclosure in order to rate more securities highly. Since ex-post distortion of information disclosure renders ex-ante collection of information irrelevant, the rating agency does not acquire information and gives every security the highest rating. Interestingly, the rating agency would still not rate bad issuers highly if they could (perfectly and costlessly) identify them. This result implies that the cost of information acquisition is an important determinant of the threshold level of regulatory benefits: higher costs decrease the threshold level of regulatory benefits for rating inflation.

In the absence of regulation, the rating agency's deviations from equilibrium play would be punished by investors through the loss of future business. Market discipline of this sort will not matter if regulatory benefits are sufficiently high: in this case, there is no commitment problem on the side of the rating agency, because everyone anticipates that the rating agency does not acquire information, and market discipline cannot induce delegated information acquisition.⁴ In contrast, a regulator could provide incentives for information acquisition using the threat of revoking regulatory accreditation.

Our paper shares main questions with recent papers by Skreta and Veldkamp (2009) and Bolton, Freixas, and Shapiro (2009). However, our modeling framework differs in two fundamental ways: a) investors are fully rational and b) ratings are influenced by the regulatory environment.⁵ Rationality implies that investors do not take ratings at face value (as in Bolton, Freixas, and Shapiro (2009)) or get fooled by "rating shopping," which refers to the issuer practice of revealing only the highest rating (see Skreta and Veldkamp (2009)). Rating shopping and the winner's curse analogy is also studied in the model of Sangiorgi, Sokobin, and Spatt (2009) who develop an equilibrium interpretation for "notching," i.e., the practice of assigning an overall company debt rating, then adjusting the ratings of specific company issues up or down a notch from the company rating.⁶ Within a rational expectations framework, the issuer-pays model, which allows for the possibility of rating shopping, does not enable the issuer to exploit the investor. Thus, the sharp criticism of the issuer-pays model by regulators – such as SEC chairman Mary Schapiro – on the basis of "inherent conflicts of interest" is not valid in a world with rational investors. Ironically, our model reveals that it is the regulatory use of

⁴ We define market discipline as a decentralized commitment device in the theoretical context of our model. If the rating agency deviated from equilibrium play, investors would not trust ratings going forward and thus not provide better financing terms for higher ratings. This in turn commits the issuer not to pay for ratings. *Ex ante*, this provides positive incentives for the rating agency. We believe that this is a meaningful definition of the term "market discipline" (see Hellwig (2005) for a critical discussion of the notion of "market discipline").

⁵ The regulatory use of ratings has to be distinguished from the regulation of rating agencies which is the focus of Stolper (2009).

⁶ See also John, Ravid, and Reisel (forthcoming).

ratings that creates conflicts of interest, albeit of a different kind.⁷

Lizzeri (1999) considers the optimal disclosure policy of a general information certifier which can perfectly observe the type of the seller at zero cost.⁸ He shows that if the lowest types create positive value to the buyer, the information certifier will not disclose any information. Intuitively, the information provider does not affect total surplus in this scenario (different than in our setup), so that any provided information would have only redistributive effects.⁹ Our main departure from his seminal paper is that we do not just consider the disclosure policy of a committed certifier but also study the ex-ante incentive of the certifier to acquire information as well as the interaction of information acquisition with the disclosure policy. This interplay becomes particularly relevant when we analyze the distortions of information acquisition created by rating-contingent regulation.

The joint analysis of continuous information acquisition and the optimum disclosure rule extends classical papers on information asymmetries in asset markets in which (some) agents are either endowed with private information (see Admati and Pfleiderer (1986)) or are not able to vary the precision of their signals such as in Grossman and Stiglitz (1980) or Hellwig (1980). We believe that the joint analysis of these questions is important: intuitively, if information disclosure is diluted *ex post*, given information, effort to collect information *ex ante* is distorted. The monopolistic seller of information in the seminal paper by Admati and Pfleiderer can also be interpreted as a rating agency using an investor-pays business model. It is important to notice that investors in a competitive financial market do not care about the precision of information per se; they are only interested in superior information relative to other (non-informed) investors. Thus, investors are not willing to pay for information that is released to the general public. It is apparently not a coincidence that the investor-pays model was abandoned in favor of the issuer-pays model in the 1970's following the widespread availability of photocopiers (see White (2007) and Sangiorgi, Sokobin, and Spatt (2009)). Moreover, the use of ratings for regulatory purposes which started in the late 1970s effectively prohibits the exclusivity of rating information and therefore renders the investor-pays model not viable.

Inderst and Ottaviani (2009) study the role of general advisors who can acquire and disclose customer-specific information in a rational-expectations setting: for example, doctors can recommend appropriate treatments to their patients but may be influenced by kickbacks that they receive from pharmaceutical companies. Our setup differs because rating agencies do not provide customer-matched information. More importantly, the advice (the rating) is used by a contractually unrelated third party (the government) in a payoff-relevant way. This makes

⁷ Our paper shares with Bond, Goldstein, and Prescott (2010) the notion that a regulator should anticipate mutual feedback effects between regulations that are based on market outcomes and the market outcomes themselves. Yet, they do not consider a rating agency (or any other financial intermediary) as the provider of the signals that are used as an input for a corrective action/regulation. Instead, the authors consider equilibrium prices in a decentralized market. In their model, the distortions in signals are thus not the result of changed incentives for a financial intermediary, but a consequence of the fact that forward looking prices reflect expected market-based actions which in turn may diminish the informational content of the equilibrium price. Farhi, Lerner, and Tirole (2008) explore various strategic dimensions of the certification market such as the publicity given to applications, the coarseness of rating patterns, and the sellers' dynamic certification strategies.

⁸ Note, that the seller in his setup sells 100% of the assets. Thus, his setup corresponds better to an entrepreneur who sells off the entire equity of a firm rather than an entrepreneur who issues debt and remains the residual cash flow claimant.

⁹ This extreme result does not hold if the certifier can charge different fees from each type, types have different outside options, or some types create negative value.

advice valuable independently of the information it provides and creates distortions. To our knowledge, this feature is largely unstudied in the existing literature even though it applies to many regulatory or quasi-regulatory settings such as auditing.¹⁰ Thus, while our model uses the concrete institutional focus on rating agencies, the results should apply more broadly to environments where messages exchanged between two parties are mechanically used by a third party.

The market structure for certification providers has been analyzed by various papers. While Strausz (2005), Ramakrishnan and Thakor (1984) and Diamond (1984) predict that certification providers are essentially natural monopolists, Lizzeri (1999) finds the opposite effect. Fundamentally, these opposite predictions result from the fact that market power in the first three papers tends to reduce commitment problems which Lizzeri abstracts from. Recent empirical evidence by Becker and Milbourn (2008) indicates that competition decreases ratings precision. However, Doherty, Kartasheva, and Phillips (2009) show that an entrant to the rating agency industry in the insurance market provides more information about selected firms within a rating pool.

Two recent empirical papers by Kraft (2008) and Tang (2006) shed more light on the work of rating agencies for corporate issues. Tang (2006) uses Moody's credit rating refinement from 9 to 19 categories in 1982 as a natural experiment. He documents that the associated increase in precision has significant economic implications for firms' credit market access and real outcomes. This is very much consistent with the role of rating agencies in reducing information asymmetries in our benchmark model. Kraft (2008) finds that ratings primarily reflect adjustments to financial statements (by incorporating off-balance sheet items) rather than soft information.

With regards to structured finance products, Benmelech and Dlugosz (2008) add another piece of evidence for rating inflation: in their sample roughly 70% of CDO issues were rated AAA. Griffin and Tang (2009) report that actual sizes of AAA rated tranches for CDOs in their sample are on average 12.1% larger than the sizes that would be implied by the rating agency's own model. These adjustments to the rating agency model exhibit a clear pattern of low model-implied AAA CDOs receiving larger adjustments, and CDOs with larger adjustments experience worse subsequent performance. Coval, Jurek, and Stafford (2008) provide a comprehensive analysis of the economics behind structured finance. Rajan, Seru, and Vig (2008) point out that statistical models based on past data which do not account for changed incentives of economic agents are subject to a Lucas critique. In their setup, changed lender incentives are caused by the increasing degree of securitized loans. Keys, Mukherjee, Seru, and Vig (2008) document that securitization practices adversely affected the screening incentives of lenders.

The benchmark model is outlined in Section 2. The feedback effect of current regulations is presented in Section 3. Section 4 considers a repeated game setup that illustrates the importance of rating multiple securities. Section 5 concludes.

¹⁰ There are also important differences to auditors: while auditors check verifiable (*ex post*) performance, credit rating agencies collect information *ex ante* about expected future performance. More broadly, we think that the auditors' role is primarily to mitigate moral hazard (cash flow diversion) rather than adverse selection (as in our paper). Credible auditing seems to be more important for equity holders (whose payoffs depends on earnings) rather than to debt holders as long as sufficient punishments can be imposed upon default (see Townsend (1979), Diamond (1984), and Gale and Hellwig (1985)).

2 Benchmark Model

2.1 Setup

The baseline model features an asymmetric information environment in which firms have superior information about the quality of their projects relative to investors, a.k.a. a standard privately-known prospects textbook model (see chapter 6.2 of Tirole (2005)). Our contribution is to incorporate a monopolistic rating agency into this setup. The regulatory use of ratings will be introduced in the subsequent section. All players (firms, investors and a rating agency) are assumed to be risk-neutral.

There is a continuum of firms of measure 1. Each firm is owned by a risk-neutral entrepreneur who has no cash. The entrepreneur has access to a risky project that requires an initial investment of 1 and may either succeed or fail. If the project succeeds, the firm's net cash flow at the end of the period is $R > 1$. In case of failure, the cash flow is 0. Firms differ solely with regards to their probability of success.¹¹ In particular, there are two firm types $n \in \{g, b\}$ with respective default probabilities d_n , where g represents "good" and b stands for "bad."¹² Although only entrepreneurs observe their projects' types, the fraction of good types in the population π_g is common knowledge. The *NPV* of a type- n project is given by

$$V_n = R(1 - d_n) - 1. \quad (1)$$

The good type has positive *NPV* projects ($V_g > 0$), whereas the bad type has negative *NPV* projects ($V_b < 0$). The average project with default probability $\bar{d} = \pi_g d_g + \pi_b d_b$ is assumed to have negative *NPV*.¹³

Firms seek financing from competitive investors via the public debt market.¹⁴ Since investors require a non-negative *NPV* on each investment, given available public information, the average project cannot be financed. Firms have access to an alternative costly financing channel which can be interpreted as a reduced form way of accounting for the possibility of relationship lending (through banks) or other ways of costly information revelation. This channel gives rise to an outside option for good types with *NPV* $0 \leq \bar{U}_g \leq V_g$. Type dependent outside options of this kind can be found in Laffont and Tirole (1990) and represent the intuitive notion that good types have access to "bypass" technologies that allow them to bypass the public debt market. The effective cost of these technologies, $V_g - \bar{U}_g$, is wasteful from a social planner's perspective.¹⁵ In the following, we treat \bar{U}_g as an exogenous parameter and analyze how it affects the optimizing behavior of rating agencies.

Firms can approach rating agencies which have access to an information production technology that generates private signals $s \in \{A, B\}$ of firm type. The quality of the signal depends on the agency's choice of the information acquired, $\iota \in [0, 1]$. We consider the following signal

¹¹ Firms are assumed to default on their contracts with investors if and only if their projects fail. Consequently, we refer to the probability of failure as the *default* probability.

¹² An earlier version of this paper contained three firm types. For ease of exposition, we now focus on a 2-type setup. The results are qualitatively identical.

¹³ This assumption can be relaxed somewhat without affecting our results, but it simplifies the exposition.

¹⁴ The exact nature of the security issued is not important for our purposes. Given our simple, two-outcome projects with verifiable outcomes and zero payoff in the "failure" state, all securities are equivalent. We refer to the security issued as debt in keeping with the fact that, in reality, only debt-like securities are rated.

¹⁵ If $\bar{U}_g = 0$ these bypass technologies are prohibitively costly.

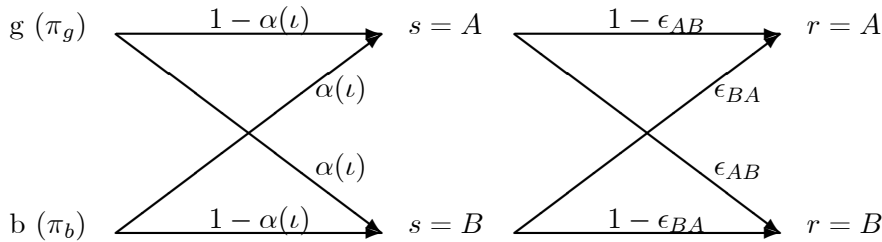


Figure 1: Signal Structure and Disclosure Rules

structure. Good firm types receive the good signal A with probability $1 - \alpha(\iota)$ and obtain a bad signal, B , with probability $\alpha(\iota)$. Conversely, bad types obtain the signal B with probability $1 - \alpha(\iota)$ and the signal A with probability $\alpha(\iota)$. Thus, $\alpha(\iota)$ can be interpreted as the error probability that the rating agency's information technology generates.¹⁶ The signal structure is depicted graphically in the diagram on the left side of Figure 1. Note that these "honest" errors are different from the noise that the rating agency can create by strategically misreporting the obtained signal (which we will discuss below). By definition of a good signal, the good type obtains the good signal more frequently than the bad type for any positive level of information acquisition, i.e.,

$$\alpha(\iota) \leq \frac{1}{2}. \quad (2)$$

Without loss of generality, information acquisition is normalized between 0 and 1, where $\iota = 0$ indicates no information is acquired, and $\iota = 1$ indicates the acquisition of perfect information. Thus

$$\alpha(0) = \frac{1}{2}, \text{ and} \quad (3)$$

$$\alpha(1) = 0. \quad (4)$$

It is convenient and without loss of generality to assume that α is affine, i.e.,

$$\alpha(\iota) = \frac{1 - \iota}{2}.^{17} \quad (5)$$

The cost function for information acquisition $C(\iota)$ is increasing and convex, satisfying

$$C'(0) = 0, C(0) = 0, \text{ and} \quad (6)$$

$$\lim_{\iota \rightarrow 1} C'(\iota) = \infty. \quad (7)$$

Since signals s are not publicly observable, the rating agency can potentially assign ratings $r \neq s$. Consistent with practice, the message space is restricted to a letter rating. Thus, a disclosure rule is completely characterized by the probabilities of misreporting, $\varepsilon = (\varepsilon_{AB}, \varepsilon_{BA})$, conditional on the privately observed signal $s \in \{A, B\}$. The term ε_{AB} refers to the probability

¹⁶ All results would go through if the error probabilities were different for different type firms. We briefly consider the effect of different error probabilities in connection with the comparative statics results in Proposition 4.

¹⁷ The affine functional form for α is not without loss of generality if the error probabilities are different for different type firms, but our results require only that the error probabilities are decreasing in information acquisition and weakly convex.

that an issuer with signal A is rated B (ε_{BA} is defined analogously). The disclosure rule is depicted graphically in the diagram on the right side of Figure 1. Formally equivalent, the rating agency could also report the implied posterior type attributes, i.e., it could issue a report that specifies the probability that a specific firm is of type \tilde{n} . Full disclosure implies $\varepsilon = (0, 0)$. Without loss of generality, we restrict ourselves to disclosure rules which ensure that the A category represents the superior rating class.¹⁸

In the following analysis, we assume that the value of future business (reputation) is high enough that the rating agency can effectively commit to any desired level of information acquisition $\iota \geq 0$ and any disclosure rule $\varepsilon \geq 0$. This assumption can be formally justified within a repeated game setup outlined in Section 4. We want to stress that this assumption – while potentially controversial for other questions – works against the main result of the paper.¹⁹

For its rating services, the rating agency charges a fee f that must be paid upon a successful capital market issue. This captures the standard business practice of the rating agency. Also, consistent with reality, the rating agency cannot take an equity stake in any firm.

The sequence of events in the game played by the participants is:

1. The rating agency sets fee f , information acquisition ι and the disclosure rule ε .
2. Firms decide whether to get a rating or not.
3. For firms choosing to obtain a rating, the rating agency receives private noisy signal s .
4. The rating agency reports public rating r .
5. Investors decide whether to provide funding to firms.
6. Firms that obtain financing pay the fee f and invest funds.
7. Cash flows are realized at the end of the period, and debt is repaid if possible.

2.2 Analysis

Let p_n be an indicator function that is 1 if firms of type n obtain ratings and is 0 if they don't. Let $p = (p_g, p_b)$. We refer to a firm's decision whether to obtain a rating as its *participation decision*.

The symmetric Perfect Bayesian Equilibrium (in which all firms of the same type play the same strategy) is defined as follows.

Definition 1 *Equilibrium:*

1) Investors set face values N_r (financing terms) to break-even for each rating class r given the firms' participation decisions p , the information acquisition level ι , the disclosure rule ε and the fee f .

¹⁸ For example, the rule "always misreport," $\varepsilon = (1, 1)$, is informationally equivalent to $\varepsilon = (0, 0)$. In such a case, we could simply relabel the categories and our analysis goes through.

¹⁹ It would be trivial to generate distortions of information acquisition in a setup in which the rating agency does not care about reputational capital.

2) Each firm makes a participation decision to maximize the net present value of its cash flows given its type, n , the fee structure, f , the rating quality, ι , the disclosure rule, ε , and the financing terms for each rating class, N_A and N_B .

3) The rating agency sets a fee, f , information acquisition, ι , and a disclosure rule, ε , that maximizes its profits given the firms' participation decisions and the financing terms required by investors.

For ease of exposition, the profit maximization problem of the rating agency is solved in three steps. We first solve the investor problem (1), then the firm problem (2) to simplify the rating agency decision problem (3). This solution approach is similar to Grossman and Hart (1983).

2.2.1 Investor Problem

First consider investors' strategies taking firms' and the rating agency's strategy as given. Let μ_s denote the mass of firms for which the rating agency obtains the signal s :

$$\mu_A(p, \iota) = p_g \pi_g (1 - \alpha(\iota)) + p_b \pi_b \alpha(\iota), \quad (8)$$

$$\mu_B(p, \iota) = p_g \pi_g \alpha(\iota) + p_b \pi_b (1 - \alpha(\iota)). \quad (9)$$

Given a disclosure rule ε , the mass of firms with a reported rating of $r \in \{A, B\}$, denoted by $\tilde{\mu}_r$, satisfies

$$\tilde{\mu}_A(p, \iota, \varepsilon) = \mu_A(1 - \varepsilon_{AB}) + \mu_B \varepsilon_{BA}, \quad (10)$$

$$\tilde{\mu}_B(p, \iota, \varepsilon) = \mu_B(1 - \varepsilon_{BA}) + \mu_A \varepsilon_{AB}. \quad (11)$$

Moreover, let $d_r(p, \iota, \varepsilon)$ represent the posterior default probability of a firm in rating class r . Then

$$d_A(p, \iota, \varepsilon) = \pi_g p_g \frac{(1 - \alpha(\iota))(1 - \varepsilon_{AB}) + \alpha(\iota) \varepsilon_{BA}}{\tilde{\mu}_A} d_g + \pi_b p_b \frac{(1 - \alpha(\iota)) \varepsilon_{BA} + \alpha(\iota)(1 - \varepsilon_{AB})}{\tilde{\mu}_A} d_b,$$

$$d_B(p, \iota, \varepsilon) = \pi_g p_g \frac{(1 - \alpha(\iota)) \varepsilon_{AB} + \alpha(\iota)(1 - \varepsilon_{BA})}{\tilde{\mu}_B} d_g + \pi_b p_b \frac{(1 - \alpha(\iota))(1 - \varepsilon_{BA}) + \alpha(\iota) \varepsilon_{AB}}{\tilde{\mu}_B} d_b.$$

Competition among investors ensures that the required face value of bonds with rating r is given by

$$N_r(p, \iota, \varepsilon, f) = \frac{1 + f}{1 - d_r}. \quad (12)$$

Investors provide financing as long as $N_r \leq R$.

The off-equilibrium path beliefs of investors are specified as follows. If $p = (0, 0)$ investors assign a default probability d_g to any *rated* firm, regardless of the rating. If $p = (1, 1)$, investors assign a default probability of d_b to any *unrated* firm.

Lemma 1 *If both firm types get rated, at most one rating class (called A) may obtain financing, irrespective of the level of information acquisition ι and the disclosure rule ε . Financing of rated firms requires participation of good types.*

²⁰ We ignore discounting as this would not affect the results but would add to the notational burden.

Proof: Suppose both rating classes get financed. Then the population of firms would get financed as $p = (1, 1)$ by assumption. On average, however, projects have negative NPV . Hence, the break-even constraint of investors, equation 12, would be violated for any $N_r \leq R$. If only the bad type firms get rated, i.e., $p = (0, 1)$, investors assign a default probability d_g to any unrated firm and a default probability d_b to any rated firm. Thus, only unrated firms would be financed. ■

2.2.2 Firm Problem

Now consider the decision of a firm of type n to approach the rating agency for a rating, taking the strategies of all investors, the rating agency and all other firms as given.

Lemma 2 *Bad types have a strict incentive to get rated if $N_A < R$.*

The intuition for this lemma is straightforward. Due to limited liability, approaching the rating agency is a free option for the bad type firm: if it is lucky to obtain an A-rating (either due to an honest mistake or misreporting by the rating agency), it will obtain a positive expected payoff. Otherwise its payoff is simply zero. Lemmas 1 and 2 together imply that bad types always mimic the good type. If both types remain unrated, financing through the public debt market is impossible because the average project is of negative NPV. Each firm would simply get its outside option \bar{U}_n .

By Lemma 1 rational investors only fund A rated securities with terms $N_A < R$ if good types choose to participate. This crucial participation decision will enter as a (binding) constraint in the rating agency problem which is studied in the next section. To keep the analysis as simple as possible, we assume that firms have access to their outside option regardless of their rating. Since fees are only paid upon a successful capital market issue – which is precluded by a B -rating – good firms will only approach the rating agency if the expected payoff conditional on an A -rating is greater than their outside option \bar{U}_g , i.e., if

$$(1 - d_g)(R - N_A) \geq \bar{U}_g. \quad (13)$$

Defining the threshold face value of debt $\bar{N} < R$ as the maximum face value entrepreneurs are willing to promise investors, i.e., \bar{N} satisfies $(1 - d_g)(R - \bar{N}) = \bar{U}_g$, we obtain a simple participation strategy of the good type:

$$p_g^* = \begin{cases} 1 & \text{if } N_A \leq \bar{N}, \\ 0 & \text{if } N_A > \bar{N}. \end{cases} \quad (14)$$

Intuitively, good types participate only if the face value of public debt is sufficiently low.

2.2.3 Rating Agency Problem

Since the rating agency can only collect fees if they enable firms to obtain funds from capital markets the previous two subproblems imply that the rating agency must set fees f , the information acquisition level ι , and the disclosure rule ε that induce the good type to get rated ($N_A(\iota, \varepsilon, f) \leq \bar{N}$).²¹ Since $\bar{N} < R$, by Lemma 2 this also induces the bad type to get rated.

²¹ Since $p = (1, 1)$, we drop p from the argument lists of functions in this section.

Fees f may only be collected from all firms that are labelled as A (see Lemma 1).²² Thus, the equilibrium represents the solution to the following profit maximization problem of the rating agency:

$$\begin{aligned} \max_{\iota, f, \varepsilon} \Pi(\iota, f, \varepsilon) &= \tilde{\mu}_A(\iota, \varepsilon) f - C(\iota), \text{ s.t.} \\ N_A(f, \iota, \varepsilon) &\leq \bar{N}. \end{aligned} \quad (15)$$

The solution of the problem is split into three steps. First, we solve for the optimal fee f as a function of information acquisition ι and the disclosure rule ε . Second, we prove that, given the optimal fee, the optimal disclosure rule is full disclosure, $\varepsilon = (0, 0)$. Third, we solve for the optimal level of information acquisition.

The participation constraint $N_A \leq \bar{N}$ can be rewritten as a constraint on the fee using equation 12:

$$f \leq f^*(\iota, \varepsilon) = \bar{N}(1 - d_A(\iota, \varepsilon)) - 1. \quad (16)$$

Profit maximization of the rating agency implies that this constraint always binds: for a given level of informativeness implied by (ι, ε) and cost $C(\iota)$, the rating agency wants to charge the maximum possible fee f^* . It is useful to define an auxiliary variable x_n that measures the revenue contribution a firm of type n creates,

$$x_n \equiv (1 - d_n) \bar{N} - 1. \quad (17)$$

As the outside option of the good type converges to 0, i.e., \bar{N} approaches R , the revenue contribution approaches the NPV of the firm's project. Since the outside option of good types is (by assumption) between 0 and the NPV of the project, x_n must be strictly smaller than the associated NPV :²³

$$x_b < V_b < 0 < x_g < V_g. \quad (18)$$

We now turn to the optimal disclosure rule for the rating agency.

Proposition 1 *Full Disclosure is optimal for all (relevant) levels of information acquisition, i.e., $\varepsilon = \mathbf{0}$.*

Proof: Given the optimal fee level $f^*(\iota, \varepsilon)$, revenue $S(\iota, \varepsilon)$ is just a function of information acquisition and the disclosure rule ε . Full-disclosure revenue can be written as

$$S(\iota, \mathbf{0}) = (1 - \alpha(\iota)) \pi_g x_g + \alpha(\iota) \pi_b x_b. \quad (19)$$

For an arbitrary disclosure rule, revenue can be decomposed into the full-disclosure revenue and the deviation from full disclosure:

$$S(\iota, \varepsilon) = \underbrace{S(\iota, \mathbf{0})}_{\text{Full-Disclosure Revenue}} + \underbrace{[\pi_g x_g \alpha(\iota) + \pi_b x_b (1 - \alpha(\iota))] \varepsilon_{BA} - S(\iota, \mathbf{0}) \varepsilon_{AB}}_{\text{Revenue from Full-Disclosure Deviation}}. \quad (20)$$

²² As B -rated firms do not generate revenue, the rating agency does not even need to publish bad ratings.

²³ Formally, the relation $0 < \bar{U}_g < V_n$ implies that: $(1 - d_g) \bar{N} > 1$ and $\bar{N} < R$.

Thus, for a fixed ι , the revenue (and thus profits) of the rating agency is linear in ε_{AB} and ε_{BA} . The coefficient on ε_{BA} is given by

$$\frac{dS}{d\varepsilon_{BA}} = \pi_g x_g \alpha(\iota) + \pi_b x_b (1 - \alpha(\iota)) \quad (21)$$

$$< (1 - \alpha(\iota)) (\pi_g x_g + \pi_b x_b) \quad (22)$$

$$< (1 - \alpha(\iota)) (\pi_g V_g + \pi_b V_b) < 0. \quad (23)$$

The first relation follows because $\alpha(\iota) < 1 - \alpha(\iota)$ and $x_g > 0$. The second one follows from $x_n < V_n$. The third one follows from the assumption that the average project is not worthwhile financing. Thus, for any ι , revenue is decreasing in ε_{BA} . Hence, it must be optimal to choose $\varepsilon_{BA} = 0$.

Now, consider ε_{AB} . The coefficient on ε_{AB} is given by

$$\frac{dS}{d\varepsilon_{AB}} = -S(\iota, \mathbf{0}). \quad (24)$$

The revenue under full disclosure $S(\iota, \mathbf{0})$ must be nonnegative in equilibrium, for suppose $S(\iota, \mathbf{0}) < 0$. Then $\varepsilon^* = (0, 1)$, and $S(\iota, \varepsilon^*) = S(\iota, \mathbf{0}) - S(\iota, \mathbf{0}) = 0$, for any ι , which is a contradiction. ■

The intuition for this proof is simple. Labeling B firms as A ($\varepsilon_{BA} > 0$) reduces profits through 2 channels. First, it reduces total surplus in the economy because a higher fraction of negative NPV projects is financed. Second, it increases rents that accrue to bad firms (which are more likely to get rated A) while rents to good firms are unchanged. Therefore, the share of the pie accruing to the rating agency must decrease. Thus, the volume effect (more firms are rated A) is outweighed by the reduced fee that the rating agency can charge for its service. Labeling A firms as B ($\varepsilon_{AB} > 0$) reduces profits simply because A -rated firms have on average positive NPV projects, and some of them would no longer be financed in equilibrium. This leads to a decline in ratings volume while fees cannot be raised.

Using the optimality of full disclosure we can now characterize the equilibrium of the benchmark model (assuming that an equilibrium with positive profits of the rating agency exists).

Proposition 2 *In equilibrium*

- a) Both firm types decide to get a rating.
- b) The optimal level of information acquisition satisfies $C'(\iota^*) = -\alpha'(\iota^*) (\pi_g x_g - \pi_b x_b)$.
- c) The fee satisfies $f^*(\iota^*) = \bar{N} (1 - d_A(\iota^*)) - 1$.
- d) The fraction of financed firms is $\mu_A(\iota^*)$.
- e) Rating agency profits are given by $(1 - \alpha(\iota^*)) \pi_g x_g + \alpha(\iota^*) \pi_b x_b - C(\iota^*)$.

Proof: Parts a), c), and d) follow from the discussion in the main text. Using full disclosure, the profit of the rating agency conditional on any level of information acquisition ι satisfies

$$\Pi = \mu_A(\iota) f^*(\iota) - C(\iota) \quad (25)$$

$$= (1 - \alpha(\iota)) \pi_g x_g + \alpha(\iota) \pi_b x_b - C(\iota). \quad (26)$$

The optimal level of information acquisition must solve the first-order condition,

$$-\alpha'(\iota^*) (\pi_g x_g - \pi_b x_b) - C'(\iota^*) = 0. \quad (27)$$

The second order condition is satisfied since $\alpha''(\iota) = 0$ and $C''(\iota)$ is positive. The restrictions on the cost function and the errors ensure that there exists a unique interior level of information acquisition $0 < \iota^* < 1$. This proves part b). Part e) follows directly. ■

The optimal level of information trades off the marginal cost of information acquisition $C'(\iota^*)$ with the marginal private benefit of information acquisition which results from increasing the proportion of good projects by $-\alpha'(\iota^*)\pi_g > 0$ and decreasing the proportion of bad projects by $\alpha'(\iota^*)\pi_b < 0$. Each additional good project undertaken generates a revenue contribution of x_g to the rating agency while each bad project avoided generates a value of $|x_b|$. Since $x_n < V_n$, the choice of information acquisition does not equalize marginal cost to the marginal social benefit, $-\alpha'(\iota^*)(\pi_g V_n - \pi_b V_b)$, because the rating agency cannot extract the full *NPV*, since firms have an outside option with positive *NPV*.²⁴

3 Rating-Contingent Regulation

This central section of the paper extends the previous ones by incorporating the effects of regulatory use of ratings into our existing framework (see examples in the Introduction). The existing regulations or quasi-regulations imply that investors receive a regulatory benefit from "higher" rated securities independent of the underlying risk of the securities. Empirically, the *AAA* threshold and the investment grade threshold are of highest relevance to investors. Though our model features only two rating classes, our results can be extended to multiple rating classes. We assume that a regulator is committed to its policy.²⁵

Assumption 1 *The marginal investor is regulated and receives an equivalent monetary benefit of $y < |x_b|$ for each A-rated bond.*

This assumption is important for the remainder of the analysis. It can be motivated on theoretical and empirical grounds. In the framework of intermediary asset pricing by He and Krishnamurthy (2008), intermediaries – i.e. regulated entities – are marginal in setting asset prices. Thus, prices of two equivalent bonds with different ratings should command different prices if regulatory constraints bind. This logic is analogous to the collateral channel in Garleanu and Pedersen (2009) which may lead to deviations from the law of one price. Empirically, our assumption is consistent with the study of Strahan and Kisgen (2009) who find that higher rated bonds require significantly lower yields even after controlling for the risk of the underlying issue.

The quantity $\frac{y}{1+f}$ can be interpreted as the percentage yield reduction that investors are willing to accept solely for the *A* label. It captures the comparative statics relative to a regulated economy without preferential treatment for *A*-rated securities. The restriction on the size of the regulatory benefit $y < |x_b|$ ensures that the revenue contribution per unit of financed bad project is still negative. Thus, if information acquisition were costless, the rating agency would still not have an incentive to label bad types as *A*. The effective regulatory subsidy implies that the face value for *A*-rated securities now satisfies

$$N_A(\iota, \varepsilon, f)(1 - d_A) = 1 + f - y. \quad (28)$$

²⁴ Theoretically, the marginal social benefit should also account for (positive or negative) project externalities which we do not explicitly consider.

²⁵ Within the repeated game section, we briefly discuss the implications of allowing for endogenous changes in government regulation.

Thus firms can now raise y more units of capital from investors in return for a given promised payment. The rating agency can extract this increase in the form of a higher fee:

$$\check{f}^*(\iota, \varepsilon, y) = \bar{N} [1 - d_A(\iota, \varepsilon)] - 1 + y. \quad (29)$$

By redefining the revenue contribution of each type as $\check{x}_n = x_n + y$, the mathematical problem of the rating agency is essentially unchanged. Since it was optimal to disclose firms with an A -signal as A ($\varepsilon_{AB} = 0$) in the absence of regulatory benefits for A -rated securities, this must also hold in the presence of regulatory benefits. Thus, it is sufficient to analyze the incentives for misreporting B -signals as A . To economize on notation, the choice variable ε_{BA} will now be labeled simply ε .

Proposition 3 *Full Disclosure is optimal if*

$$y \leq \bar{y} \equiv \frac{-\pi_b x_b [1 - \alpha(\iota^*(y))] - \alpha(\iota^*(y)) \pi_g x_g - C(\iota^*(y))}{\pi_b (1 - \alpha(\iota^*(y))) + \pi_g \alpha(\iota^*(y))} \in (0, |x_b|),$$

where $\iota^*(y)$ is the optimal level of information acquisition for $y \leq \bar{y}$ defined by $C'(\iota^*(y)) = \frac{1}{2} [\pi_g \check{x}_g - \pi_b \check{x}_b]$. Otherwise, all firms are rated A ($\varepsilon = 1$) and no information ($\iota = 0$) is acquired (Rating Inflation).

Proof: The structure of the proof is similar to the proof of Proposition 1. Profits are given by

$$\Pi(\iota, \varepsilon) = S(\iota, 0) + [\pi_g \check{x}_g \alpha(\iota) + \pi_b \check{x}_b (1 - \alpha(\iota))] \varepsilon - C(\iota), \quad (30)$$

where $S(\iota, 0)$ is defined as in the previous section, except that x_n is replaced by \check{x}_n , for $n \in \{g, b\}$, i.e., $S(\iota, 0) = (1 - \alpha(\iota)) \pi_g \check{x}_g + \alpha(\iota) \pi_b \check{x}_b$.

As the objective function is linear in ε , we need consider only three cases:

Case 1) Full Disclosure: $\varepsilon = 0$. The choice of information acquisition, $\iota^*(y)$, maximizes $S(\iota, 0) - C(\iota)$.

Case 2) Rating Inflation: $\varepsilon = 1$. In this case, no information ($\iota = 0$) is acquired, because there is no point in investing in information *ex ante* if it will not be used *ex post*.

Case 3) Partial Rating Inflation: $0 < \varepsilon < 1$. In this case, the coefficient on ε in the objective function must be 0.

We will first show that Case 3 cannot occur in equilibrium because it yields lower profits than full disclosure profits (Case 1). Since partial inflation requires the coefficient on ε to be 0, the associated information acquisition level ι^{**} must satisfy $\pi_g \check{x}_g \alpha(\iota^{**}) + \pi_b \check{x}_b (1 - \alpha(\iota^{**})) = 0$.²⁶ This would imply that profits are given by

$$\Pi(\iota^{**}, \varepsilon) = S(\iota^{**}, 0) + [\pi_g \check{x}_g \alpha(\iota^{**}) + \pi_b \check{x}_b (1 - \alpha(\iota^{**}))] \varepsilon - C(\iota^{**}), \quad (31)$$

$$= S(\iota^{**}, 0) - C(\iota^{**}) < \max_{\iota} S(\iota, 0) - C(\iota) = S(\iota^*(y), 0) - C(\iota^*(y)). \quad (32)$$

Thus, it is only necessary to compare the profits under full disclosure and rating inflation. Under full disclosure, the optimal level of information acquisition, $\iota^*(y)$, must satisfy the first-order condition, $C'(\iota^*(y)) = \frac{1}{2} [\pi_g \check{x}_g - \pi_b \check{x}_b]$. The rating agency's expected profits for cases 1 and 2 are

$$\Pi(\iota^*(y), 0) = [1 - \alpha(\iota^*(y))] \pi_g \check{x}_g + \alpha(\iota^*(y)) \pi_b \check{x}_b - C(\iota^*(y)), \text{ and} \quad (33)$$

$$\Pi(0, 1) = \pi_g \check{x}_g + \pi_b \check{x}_b. \quad (34)$$

²⁶ If there is no ι that satisfies this condition, case 3 is not possible.

The difference in profits, $\Delta\Pi(y) = \Pi(\iota^*(y), 0) - \Pi(0, 1)$, is a function of y satisfying $\Delta\Pi(0) > 0$ (see proof of Proposition 1) and $\Delta\Pi(|x_b|) < 0$.²⁷ Thus, the existence of a unique threshold level $\bar{y} \in (0, |x_b|)$ can be proved by establishing that $\Delta\Pi'(y) < 0 \forall y \in (0, |x_b|)$. Using the envelope theorem, the derivative is given by

$$\Delta\Pi'(y) = -\pi_g \alpha(\iota^*(y)) - [1 - \alpha(\iota^*(y))] \pi_b < 0. \quad (35)$$

The threshold level \bar{y} can be obtained by setting $\Delta\Pi(\bar{y}) = 0$. ■

This proposition reveals that regulatory benefits can have extreme consequences: once regulatory benefits are sufficiently high ($y > \bar{y}$), the rating agency stops acquiring any information ($\iota = 0$) and rates all firms as A , including firms with a bad signal ($\varepsilon = 1$). Interestingly, at the threshold level \bar{y} , the level of information acquisition drops discontinuously to zero (see Figure 2). This is true despite the fact that a financed unit of bad types still contributes negative revenue as $y < |x_b|$: the cost of identifying these bad projects exceeds the benefit of avoiding them. The discontinuity in information acquisition can be explained as follows. Once it is profitable to choose $\varepsilon > 0$, it turns out to be optimal to set $\varepsilon = 1$, because the marginal benefit of this distortion is constant (independent of ε) while the direct cost of choosing $\varepsilon > 0$ is zero.²⁸ Given that the rating agency reports an A rating for all firms in any case, it would be wasteful first to acquire costly information to separate good types from bad types and then bunch them together *ex post*. Therefore, the rating agency chooses not to acquire information in the first place and sets $\iota = 0$.

This argument suggests that the threshold level \bar{y} is a decreasing function of the cost of information acquisition. In fact, this is the case as is shown in

Corollary 1 *For the class of cost functions $C_{c,k}(\iota) = cC(\iota) + k$ where $c, k \in \mathbb{R}^+$,²⁹ the threshold level of regulatory benefits \bar{y} is decreasing in the marginal cost parameter c and fixed cost k .*

Proof: This follows directly from the definition of the threshold level (see Proposition 3) and the envelope theorem $\left(\frac{\partial\Pi(\iota^*, 0)}{\partial\iota^*} = 0\right)$. ■

Thus, if the cost of information acquisition is higher (higher c or k), the rating inflation regime, i.e., $\iota = 0$ and $\varepsilon = 1$, becomes more attractive. Figure 2 plots the equilibrium level of information acquisition, $\iota^*(y)$, as a function of the regulatory benefits, y , for low and high marginal cost, 0.2 and 0.4, respectively.³⁰ We are first interested in the rating inflation region ($y \geq \bar{y}$) before considering the marginal impact of y in the full disclosure region. As shown in Corollary 1, the threshold level for rating inflation for low marginal cost, $\bar{y}(0.2)$, is higher than

²⁷ Recall that we constrain the subsidy y to be less than the negative contribution of the bad types to the agency's revenue, so that even with the subsidy, bad types' contribution to revenue is negative. If $y = |x_b|$, bad types contribute zero revenue in both the full-revelation case and the rating-inflation case. In the full revelation case, only good type firms with good signals contribute $x_g + y$ to revenue, while in the rating-inflation case, all good type firms contribute this amount. Thus, when $y = |x_b|$, rating inflation is better for the rating agency, i.e., $\Delta\Pi(|x_b|) < 0$.

²⁸ If there were an upper bound for the degree of distortion (less than say $\bar{\varepsilon} < 1$), the constraint would bind at this level $\bar{\varepsilon}$. This exogenous constraint could represent limits on the amount of rating inflation the regulator tolerates.

²⁹ The fixed (set-up) cost, k , is only incurred if the information acquisition level is positive.

³⁰ For this figure, $C'(\iota) = c\iota$, where c is either 0.2 or 0.4. Note, that this functional form does not satisfy the limiting properties (as ι approaches 1) which we assumed in the general analysis.

for high marginal cost, $\bar{y}(0.4)$. This result may be interpreted in the time series, driven by changes in the cost of acquiring information, or in the cross-section, i.e. across asset classes. More complex security classes, which are more costly to evaluate, should be more susceptible to rating inflation. It seems plausible, that the century-long experience of rating agencies in rating standard corporate bonds makes these assets easier to evaluate than structured securities like CDOs, which require fundamentally different evaluation skills.

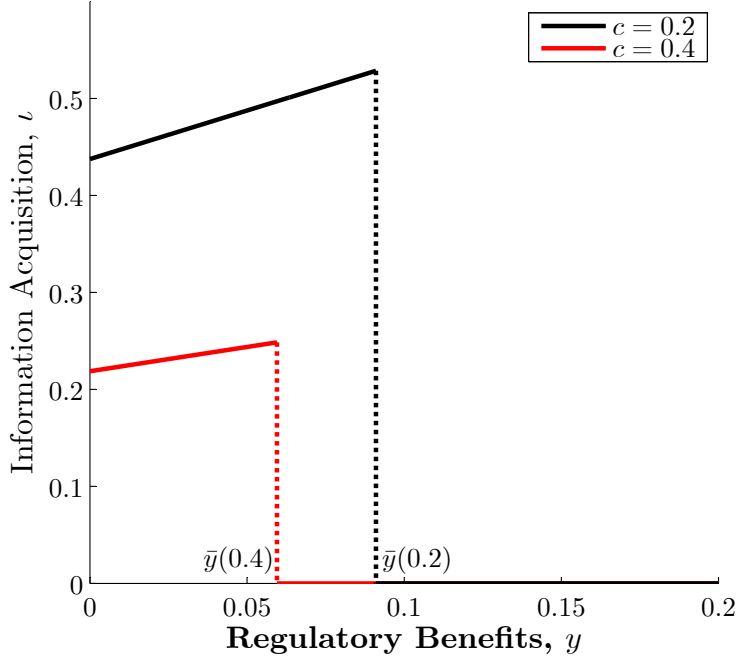


Figure 2: Comparative Statics of Regulatory Benefits (Parameters: $x_g = 0.1$, $x_b = -0.35$, $\pi_g = 0.7$, $C'(\iota) = c\iota$)

While large regulatory benefits $y > \bar{y}$ generate rating inflation and lead to excessive financing of negative NPV projects, regulatory benefits generate non-trivial comparative statics in the full-disclosure region ($y < \bar{y}$).

Proposition 4 *In the full-disclosure region ($y \leq \bar{y}$), an increase in regulatory benefits y increases information acquisition if and only if $\pi_g > \frac{1}{2}$. Otherwise information acquisition is decreased. The mass of A-rated firms strictly increases for $\pi_g \neq \frac{1}{2}$. Moreover, for a given regulatory benefit $y < \bar{y}$, an increase in the proportion of good type firms, π_g , increases information acquisition if and only if $y > \frac{x_g + x_b}{2}$.*

Proof: Using $\check{x}_n = x_n + y$ and $\alpha(\iota) = \frac{1-\iota}{2}$, the first-order-optimality condition for information acquisition (see Proposition 2) can be written as

$$\frac{\pi_g x_g - \pi_b x_b}{2} + \frac{\pi_g - \pi_b}{2} y = C'(\iota^*). \quad (36)$$

By the implicit function theorem, we obtain

$$\frac{d\iota^*}{dy} = \frac{\pi_g - \pi_b}{2C''(\iota^*)}. \quad (37)$$

This expression is positive if and only if $\pi_g > \frac{1}{2}$, negative if $\pi_g < \frac{1}{2}$ and zero if $\pi_g = \frac{1}{2}$. The mass of highly-rated firms is given by $\mu_A = \pi_g(1 - \alpha(\iota)) + \pi_b\alpha(\iota)$. The comparative statics satisfy

$$\frac{d\mu_A}{dy} = \frac{\partial\mu_A}{\partial\iota} \frac{d\iota^*}{dy} = \frac{\pi_g - \pi_b}{2} \frac{\pi_g - \pi_b}{2C''(\iota^*)} = \frac{(\pi_g - \pi_b)^2}{4C''(\iota^*)} \geq 0. \quad (38)$$

This expression is strictly positive for $\pi_g \neq \frac{1}{2}$.

Finally, since $\iota^*(y)$ satisfies $C'(\iota^*(y)) = \frac{1}{2}[\pi_g\check{x}_g - \pi_b\check{x}_b]$,

$$\frac{\partial\iota^*}{\partial\pi_g} = \frac{1}{2C''(\iota^*)}(\check{x}_g + \check{x}_b). \quad (39)$$

Since $C'' > 0$, $\text{sign} \frac{\partial\iota^*}{\partial\pi_g} = \text{sign}(\check{x}_g + \check{x}_b)$. The sign is positive if $y > \frac{x_g + x_b}{2}$. ■

Proposition 4 reveals that the level of information acquisition (and thus investment efficiency in the economy) may increase or decrease in response to changes in regulatory benefits, depending on the distribution of risks in the cross-section. Moreover, a change in the cross-section towards more good types increases information acquisition if regulatory benefits are sufficiently large.³¹

In Figure 2, information acquisition increases, since the fraction of good types satisfies $\pi_g > \frac{1}{2}$. The adjustment of information acquisition is more pronounced for low levels of marginal cost. These comparative statics of informativeness are driven by a "volume effect", the incentive to label more firms as *A* in response to regulatory benefits for *A*-rated securities. In the full-disclosure region, the change in the fraction of *A*-rated firms, μ_A , due to an increase in ι is increasing in the fraction of good types. If there are more good types than bad types in the economy ($\pi_g > \frac{1}{2}$), better information increases the mass of *A*-rated firms, so that equilibrium information acquisition is increased (see Figure 3). Otherwise ($\pi_g < \frac{1}{2}$), information acquisition is decreased.

Note that the sign of the comparative statics is **independent** of the payoff in the good state *R*, the level of the outside option \bar{N} , and the cost function for information acquisition $C(\iota)$.³² It depends solely on the distribution of the underlying risks, i.e., the proportions of the two types, π_n . The changes in information acquisition and the volume of *A*-rated securities are greater the more skewed the distribution of types, i.e. the more unequal the fraction of good and bad types (see Figure 3).

We now turn to two extensions of our analysis. First, we consider the case in which any positive level of information acquisition would yield negative profits in the absence of regulatory benefits, i.e. $(1 - \alpha(\iota^*))\pi_g x_g + \alpha(\iota^*)\pi_b x_b - C(\iota^*) < 0$ with $C'(\iota^*) = -\alpha'(\iota^*)(\pi_g x_g - \pi_b x_b)$. In this case, the high cost of information acquisition prevents the rating agency from operating without regulatory benefits.³³ However, if regulatory benefits, y , are sufficiently large, $y > |x_g \pi_g + x_b \pi_b|$, the business of regulatory arbitrage becomes profitable.³⁴ The rating agency would still not acquire information. Nonetheless, due to the regulatory benefits investors are

³¹ Note, that the sign of $x_g + x_b$ is ambiguous. Therefore, it is possible that information acquisition increases in the proportion of good types for the entire relevant parameter region, $y \in [0, |x_b|)$.

³² Note, that the *level* of information acquisition obviously depends on the marginal benefits (influenced by x_g and x_b) and the marginal cost (see Figure 2).

³³ So far, we implicitly assumed parameter constellations that allowed the rating agency to operate even in the absence of regulatory benefits.

³⁴ From equation 34, $y > |x_g \pi_g + x_b \pi_b|$ implies that $\Pi(0, 1) > 0$.

Comparative Statics in Full-Disclosure Region

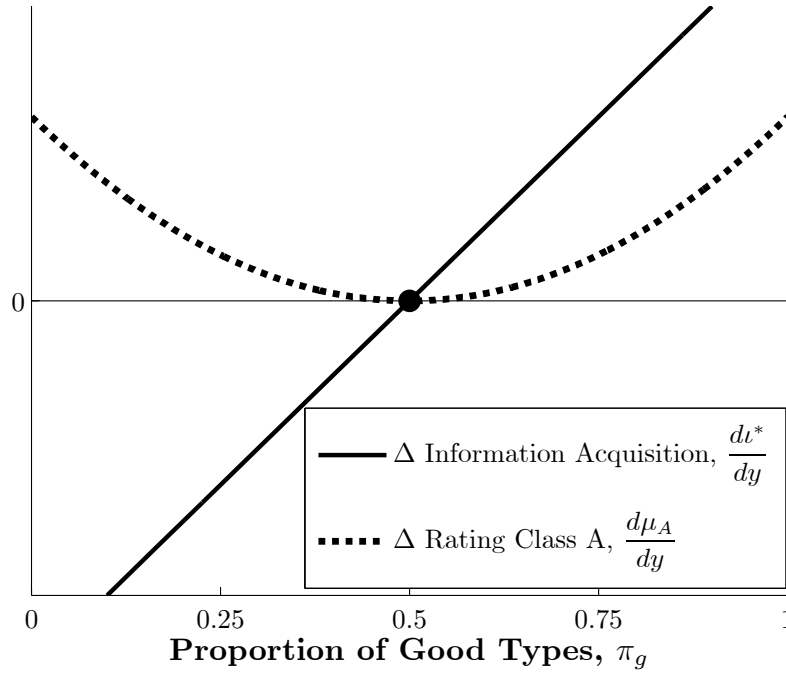


Figure 3: Comparative Statics in Full-Disclosure Region ($C''(\iota) \equiv 1$)

willing to pay for ratings enabling the rating agency to operate. Thus, if regulatory accreditation is associated with sufficiently large benefits, a rating agency finds it profitable to enter lines of businesses, such as complex securities, which are unprofitable in the absence of regulation.

Second, we analyze the robustness of our results with respect to the assumed signal structure. In our setup, the error probabilities for the rating agency's information technology, $\alpha(\iota)$, are the same for both firm types. If we allow these to differ, the results of Proposition 4 change somewhat. In particular, we consider two extreme examples:

1. No "type I" error, i.e., good types always get the high signal. This signal structure can be interpreted as an exam that is too easy. All good types get it right, but also a sizeable fraction of bad types. In this case, information acquisition in the full disclosure region is always reduced if regulatory benefits increase, because a reduction in information acquisition is the only way to increase the mass of firms with A -signals.
2. No "type II" error, i.e., bad types always get the low signal. This signal structure refers to an exam that is too hard. Bad types always fail and good types sometimes fail. In this case, information acquisition in the full disclosure region is always increased if regulatory benefits increase, because an increase in information acquisition is the only way to increase the mass of firms with A -signals.

4 Repeated Game Analysis

So far, we assumed that the rating agency can commit to any desired disclosure rule and level of information despite the fact that information acquisition is not observable. This is particularly relevant for the case $y \leq \bar{y}$ in which full disclosure is optimal under commitment. In this section, we show that this assumption can be endogenized within a repeated game in which the previous setup corresponds to the stage game Γ . Let δ represent the one-period discount factor and assume for simplicity that all relevant actions occur at the beginning of the period.³⁵ Let t index time and h^{t-1} represent the entire history of both realized defaults in rating class A and ex-ante probabilities of default of A -rated firms announced by the rating agency. Note, that the announced ex-ante probability of default is fully determined by the disclosure rule ε and information acquisition ι .³⁶

In the previous section with a committed rating agency, it was irrelevant whether each period one firm is drawn from the pool of firms or the entire cross-section of firms is rated. For the repeated game section, it turns out to be important to observe the entire cross-section of firms to enhance information about the rating agency's effort. With independence of realized defaults and signals across firms, the cross-section of firms perfectly reveals the effort choice of the rating agency to the public *ex post*, i.e., the announced default probability of $d_A(\iota)$ must coincide with the realized default probability \tilde{d}_A (assuming the rating agency does not deviate). While the independence assumption is clearly extreme, it captures an important element that holds more generally for arbitrary correlation structures, namely, cross-sectional diversification increases the precision of the signal about the effort of the rating agency and thus strengthens the reputation mechanism. The more securities a rating agency rates and the higher the future rents it can extract, the better it is committed to provide informative ratings. Since competition generates inefficient duplication of effort and generally reduces rents, a reputation based business model cannot be sustained in a competitive market. This is consistent with the oligopolistic market structure of rating agencies.

Formally, independence has the convenient feature that it allows us to use the machinery of games with perfect public information. As standard in the repeated games literature, we aim to support the best possible subgame perfect equilibrium from the perspective of the rating agency using the worst possible equilibrium as the punishment equilibrium upon deviations from equilibrium play.

Lemma 3 *The worst possible subgame perfect equilibrium features zero information acquisition $\iota = 0$ and no capital provision by investors.*

It is clearly optimal for the rating agency not to acquire any information, given that investors will not fund rating class A . Likewise, given that the rating agency does not exert effort, it is optimal for investors not to fund any rated firm. This is the worst possible subgame perfect equilibrium for the rating agency. We believe that the loss of future business is the only realistic punishment of rating agencies as freedom of speech exempts opinion providers

³⁵ This implies that the realized cash flow from a project does not have to be discounted. This assumption is not crucial, but simplifies the comparison to the previous sections.

³⁶ Also note that the term "announcement" does not reflect any special role of the announcement itself. It serves solely to coordinate on an equilibrium.

from legal sanctions. The loss of future business can also be interpreted as a form of "market discipline."

Due to the equilibrium concept of subgame perfection, it is sufficient to check sustainability by considering the best possible one-period deviation. The best possible one-period deviation involves choosing $\iota = 0$ and ε such that the realized mass of rated firms, denoted $\tilde{\mu}_A$, is consistent with the announced level of information acquisition, i.e.,

$$\tilde{\mu}_A(0, \varepsilon) = \frac{1 - \varepsilon_{AB}}{2} + \frac{\varepsilon_{BA}}{2} = \mu_A(\iota^*).^{37} \quad (40)$$

This deviation allows the rating agency to collect revenue once from A -rated firms without incurring the cost of information acquisition. The equilibrium considered in the previous section is sustainable if and only if the continuation value from future business outweighs the short-run temptation not to not acquire information, i.e., if and only if

$$\frac{S(\iota^*) - C(\iota^*)}{1 - \delta} > S(\iota^*). \quad (41)$$

This results in

Proposition 5 *Folk Theorem: If the discount factor δ is greater than $\underline{\delta} = \frac{C(\iota^*)}{S(\iota^*)}$, the equilibrium of the repeated game Γ^∞ replicates the equilibrium of the stage game Γ **with commitment** on the part of the rating agency characterized in Proposition 2.*

Note, that if $y > \bar{y}$, the incentive problem of the rating agency vanishes. Investors observe that all firms (mass 1) are rated A so that the disclosure rule and implied level of information acquisition ($\iota = 0$) is revealed through the report alone. In this case, the discount factor is irrelevant and the repeated game setup superfluous. For high regulatory benefits, reputation enforced through "market discipline" would not incentivize the rating agency to produce informative ratings. Everybody in the economy (save for the regulator) knows that the rating agency has moved into the business of regulatory arbitrage rather than providing information. In this case, disciplinary action by the regulator using the threat of removing regulatory accreditation could incentivize the rating agency to provide informative ratings.

5 Conclusion

This paper has analyzed the business model of a profit-maximizing rating agency when ratings are used for regulatory purposes. In such an environment, ratings do not just convey information about the riskiness of the underlying security, but are also influenced by regulatory considerations. Our model predicts that sufficiently large regulatory benefits for high ratings can destroy the rating agency's traditional role as a delegated information producer: the rating agency rates all firms highly and chooses not to acquire information. Rating inflation of this type is shown to be more likely in the case of complex securities that are costly to evaluate. If regulatory benefits are below a certain threshold, the rating agency optimally acquires information and fully discloses this information to the public. In this case, regulatory benefits may

³⁷ This expression follows from $\mu_A(0) = \mu_B(0) = \frac{1}{2}$.

even increase the rating agency’s incentive to acquire information. The comparative statics in the full-disclosure region depend on the cross-sectional distribution of risks in the economy.

These results suggest further empirical and theoretical extensions of our paper. First and foremost, our analysis is relevant for the planned regulatory overhaul of the financial sector. It would be interesting to incorporate an active regulator into our model that trades off the distortions in the informativeness of ratings with the potential direct benefits of regulation in dampening excessive risk-taking of financial institutions. Due to human capital constraints, it may be sensible to reduce the regulator’s information set relative to the investors’. Such an analysis would be especially interesting in the context of aggregate shocks that give rise to time varying default risks which make it more difficult to disentangle bad luck from low effort. This extension would potentially result in implications for the dynamics of rating agency distortions in the context of government regulation.

Moreover, it seems worthwhile to analyze the effect of incorporating a second rating agency into the model to understand better the effect of competition.³⁸ If competition is modeled simply in a reduced form way by limiting the rents that accrue to the rating agency (see Petersen and Rajan (1995)) our model suggests that the comparative statics with respect to an increase in regulatory benefits can also be interpreted as the comparative statics of an increase in market power. However, this reduced form modeling approach does not consider the non-trivial implications of imperfectly correlated signals across rating agencies and regulation that is contingent on multiple ratings.

On the empirical side, it would be interesting to test the feedback effect of regulation on the behavior of rating agencies using official accreditation of rating agencies as a natural experiment. While the study of Strahan and Kisgen (2009) mainly confirms the priced impact of ratings (a necessary condition for our analysis), testing the feedback effect on the rating agency’s precision of ratings is left for future research.

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³⁸ We have not considered the effect of competition in this paper because rating-based regulation and competition do not primarily matter through their interaction, but are interesting enough to study in their own right.

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